

Building your circuit

Parts needed:

a.) Breadboard	x3	
b.) MSP430G2553	x1	
c.) MSP602	x3	
d.) INA126	x1	
e.) 1 μ F capacitor	x3	
f.) 220nF capacitor	x7	
g.) 26nF capacitor	x2	
h.) 52nF capacitor	x1	
i.) 1M Ω resistor	x2	
j.) 675 Ω resistor	x1	
k.) 21k Ω resistor	x4	
l.) 2.3k Ω resistor	x1	
m.) 220 Ω resistor	x2	
n.) 51k Ω resistor	x1	
o.) 100k Ω resistor	x6	
p.) 2k Ω resistor	x3	
q.) 47k Ω resistor	x1	
r.) 39k Ω resistor	x1	
s.) 1k Ω resistor	x2	
t.) 0-20k Ω 10 turn variable resistor	x1	
u.) push button	x1	
v.) double pole double throw switch	x1	
w.) LED	x2	*NOTE* choose two different colors
x.) BJT transistor	x2	
y.) assorted length wires		

Assembly

Note: Pin holes are merely a guideline. You may select a layout that works for you.

To assist with the assembly you may use the reference images at the end of the tutorial.

Step 1:

Connect the three breadboards together.

Step 2:

Place chips on breadboards:

- a.) INA128 with pin 1 in hole 15E on breadboard 1
- b.) MCP602 with pin 1 in hole 10E on breadboard 2
- c.) MCP602 with pin 1 in hole 37E on breadboard 2
- d.) MCP602 with pin 1 in hole 45E on breadboard 2
- e.) MSP430 with pin 1 in hole 44F on breadboard 3 ***note*** we have place the MSP430 with pin 1 on the right hand side

Step 3:

Place capacitors on breadboard 1:

- a.) 220nF with positive pole in the + power row and negative pole in pin hole 4G
- b.) 220nF with positive pole in the - power row and negative pole in pin hole 4H
- c.) 220nF with positive pole in the + power row and negative pole - power row
- d.) 1 μ F with positive pole in pin hole 17H and negative pole in pin hole 25I
- e.) 1 μ F with positive pole in pin hole 28G and negative pole in pin hole 32G
- f.) 1 μ F with positive pole in pin hole 37D and negative pole in pin hole 41D

Step 4:

Place capacitors on breadboard 2:

- a.) 220nF with positive pole in pin hole 11D and negative pole in pin hole 5D
- b.) 220nF with positive pole in pin hole 12A and negative pole in GND row
- c.) 220nF with positive pole in pin hole 12H and negative pole in pin hole 18H
- d.) 220nF with positive pole in pin hole 13G and negative pole in pin hole 17E

Step 5:

Place capacitors on breadboard 3:

- a.) 26nF with positive pole in pin hole 2I and negative pole in pin hole 2F
- b.) 26nF with positive pole in pin hole 13C and negative pole in pin hole 21I
- c.) 52nF with positive pole in pin hole 10H and negative pole in GND row

Step 6:

Place resistors on breadboard 1:

- a.) 675 Ω from pin hole 15G to 15D
- b.) 100k Ω from pin hole 25F to 27D and 100k Ω from 27C to GND row (this makes a 200k Ω)
- c.) 1M Ω from pin hole 32A to GND row
- d.) 1M Ω from pin hole 41B to GND row

Step 7:

Place resistors on breadboard 2:

- a.) $21\text{k}\Omega$ from pin hole 3H to 12D
- b.) $21\text{k}\Omega$ from pin hole 5C to 11C
- c.) $2.3\text{k}\Omega$ from pin hole 11B to GND row
- d.) $21\text{k}\Omega$ from pin hole 12I to 18I
- e.) $21\text{k}\Omega$ from pin hole 13J to 24J
- f.) $100\text{k}\Omega$ from pin hole 29I to 34G and $100\text{k}\Omega$ from 34F to GND row (this makes a $200\text{k}\Omega$)
- g.) 220Ω from pin hole 37B to 46A
- h.) 220Ω from pin hole 45D to 46B
- i.) $2\text{k}\Omega$ from pin hole 46D to 52B
- j.) $1\text{k}\Omega$ from pin hole 44J to 47J
- k.) $1\text{k}\Omega$ from pin hole 46J to 47G

Step 8:

Place resistors on breadboard 3:

- a.) $100\text{k}\Omega$ from pin hole 2H to 6H and $2\text{k}\Omega$ from pin hole 6I to 10I (this makes a $102\text{k}\Omega$)
- b.) $100\text{k}\Omega$ from pin hole 10J to 15J and $2\text{k}\Omega$ from pin hole 15I to 21J (this makes a $102\text{k}\Omega$)
- c.) $51\text{k}\Omega$ from pin hole 13B to GND row
- d.) $47\text{k}\Omega$ from pin hole 54G to 54E
- e.) $39\text{k}\Omega$ from pin hole 61F to 61D

Step 9:

Place wires on breadboard 1:

- a.) wire from + power row to 16G (purple wire)
- b.) wire from – power row to 18D (yellow wire)
- c.) wire from – power row to 52J (yellow wire)
- d.) wire from + power row to 54J (orange wire)
- e.) wire from 4F to GND row (brown wire)
- f.) wire from 53F to GND row (white wire)
- g.) wire from 32F to 32E (orange wire)
- h.) wire from 37F to 37E (orange wire)
- i.) wire from 18J to 34I (purple wire)
- j.) wire from 28I to 33I (green wire)
- k.) wire from 35I to 37I (red wire)
- l.) wire from 16C to 32C (blue wire)
- m.) wire from 17B to 41C (orange wire)
- n.) wire from 25H on **breadboard 1** to 3I on **breadboard 2** (orange wire)

Step 10:

Place wires on breadboard 2:

- a.) wire from + power row to 10I (yellow wire)
- b.) wire from - power row to 13D (red wire)
- c.) wire from + power row to 37I (yellow wire)
- d.) wire from + power row to 45G (purple wire)
- e.) from 48I to nearest GND row (white wire)
- f.) wire from 52A to nearest + power row (purple wire)
- g.) wire from 48A to nearest – power row (purple wire)
- h.) wire from 47A to nearest GND row (orange wire)
- i.) wire from 40A to nearest – power row (purple wire)
- j.) wire from 17D to nearest GND row (navy blue wire)
- k.) wire from 20G to nearest GND row (red wire)
- l.) wire from 5E to 10D (green wire)
- m.) wire from 11I to 29J (yellow wire)
- n.) wire from 11J to 18J (grey wire)
- o.) wire from 12G to 19G (purple wire)
- p.) wire from 37A to 38B (red wire)
- q.) wire from 44F to 44E (orange wire)
- r.) wire from 44C to 45A (red wire)
- s.) wire from 34H to 39C (white wire)
- t.) wire from 42H to 46H (yellow wire)
- u.) wire from 10B on **breadboard 2** to 2J on **breadboard 3** (orange wire)
- v.) wire from 24I on **breadboard 2** to 21F on **breadboard 3** (orange wire)
- w.) wire from 42G on **breadboard 2** to 42H on **breadboard 3** (green wire)

Step 11:

Place wires on breadboard 3:

- a.) wire from + power row to 28J (orange wire)
- b.) wire from + power row to 40B (yellow wire)
- c.) wire from + power row to 44J (orange wire)
- d.) wire from + power row to 60J (orange wire)
- e.) wire from 62A to GND row (orange wire)
- f.) wire from 53A to GND row (orange wire)
- g.) wire from 47A to GND row (red wire)
- h.) wire from 44A to GND row (orange wire)
- i.) wire from 29B to GND row (yellow wire)
- j.) wire from 2G to 13A (green wire)
- k.) wire from 29F to 29E (orange wire)
- l.) wire from 31J to 41J (brown wire)
- m.) wire from 39I to 47I (grey wire)
- n.) wire from 43G to 50G (purple wire)
- o.) wire from 40C to 45C (green wire)
- p.) wire from 47F to 50C (blue wire)
- q.) wire from 51H to 54H (orange wire)
- r.) wire from 51C to 61G (blue wire)

Step 12:

Connect all +, -, and GND rows:

- a.) Connect the + power rows of the three boards with wire (blue wires)
- b.) Connect the - power rows of the three boards with wire (red wires)
- c.) Connect the GND rows of the three boards with wire (black wires)

Step 13:

Place misc. components:

- a.) Place variable resistor with the left pin in hole 19H on **breadboard 2**
- b.) Place push button with top left pin in hole 45E and bottom left pin in 45B on **breadboard 3**
- c.) Place DPDT button with top left pin in hole 50F on **breadboard 3**
- d.) Place LED1 with positive pole in pin hole 60G and negative pole in pin hole 55D on **breadboard 3**
- e.) Place LED2 with positive pole in pin hole 60H and negative pole in pin hole 60D on **breadboard 3**
- f.) Place transistor with collector in pin 53B, base in pin 54B, and emitter in pin 55B on **breadboard 3**
- g.) Place transistor with emitter in pin 60C, base in pin 61C, and collector in pin 62C on **breadboard 3**

Step 14:

Locations for battery, electrodes and Bluetooth:

- a.) The positive battery node goes to pin 54J, the reference goes to pin 53J, and the negative goes to pin 52J on **breadboard 1**
- b.) The two external electrodes go to pins 35A and 33A and the reference goes to pin 34A on **breadboard 1**
- c.) The V_{CC} pin on the Bluetooth goes to 28B, the GND pin goes to 29B, the TXD pin goes to 30B, and the RXD pin goes to 31B on **breadboard**

Reference Images

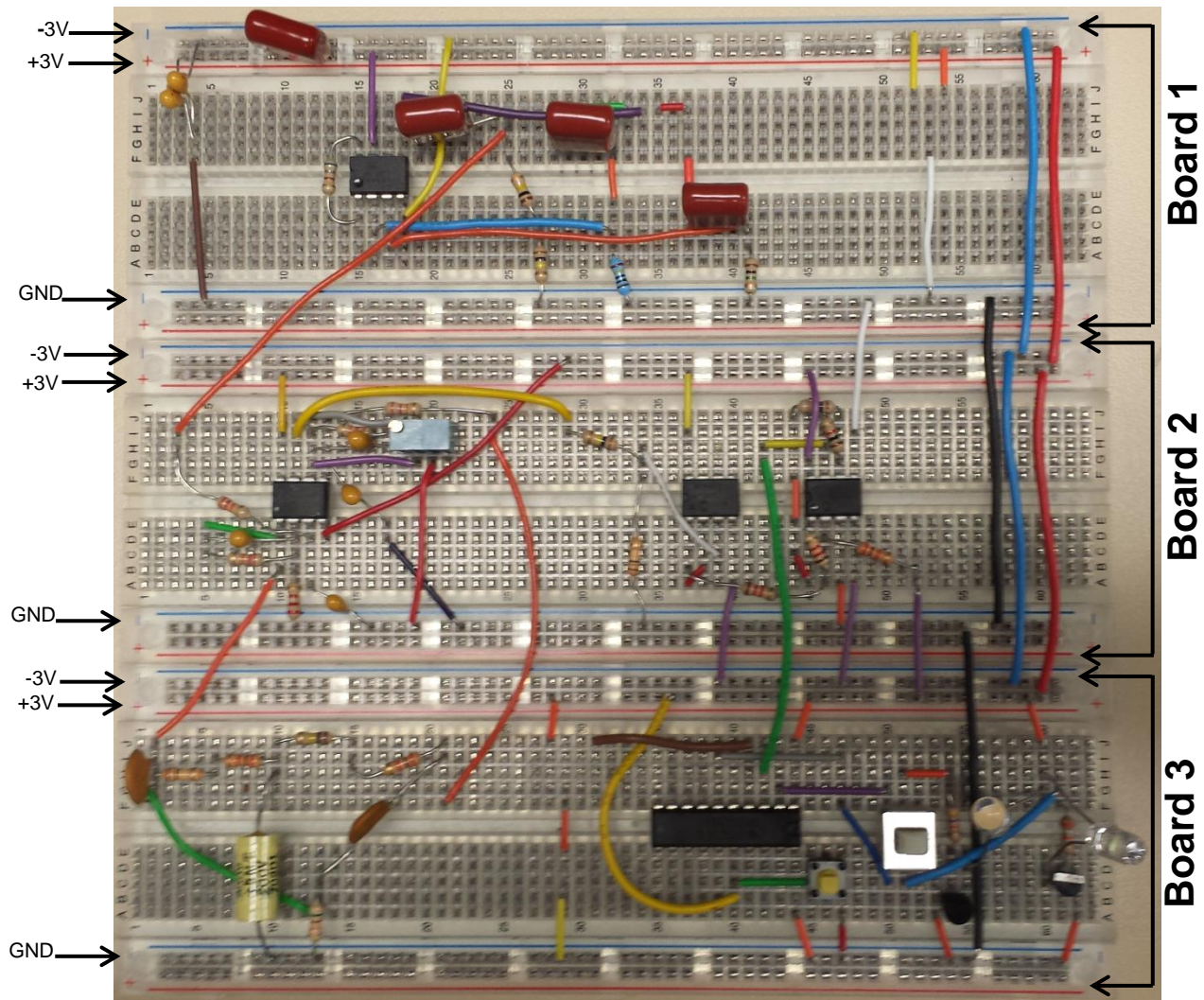


Fig 1: Overview of the Three Breadboards

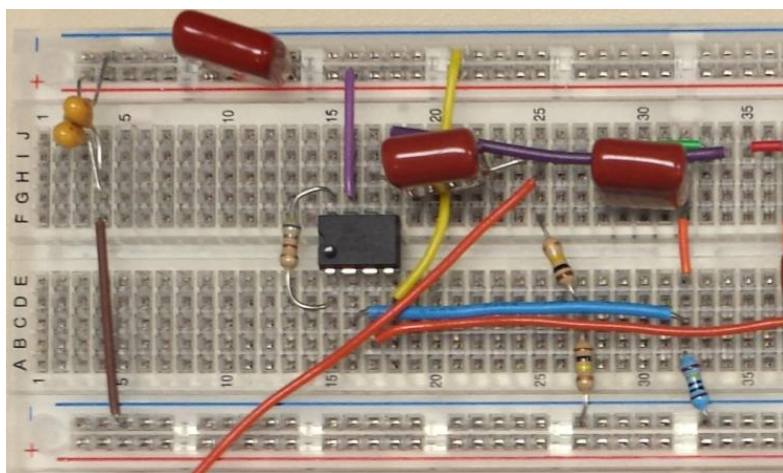


Fig 2: Left Half of Breadboard 1

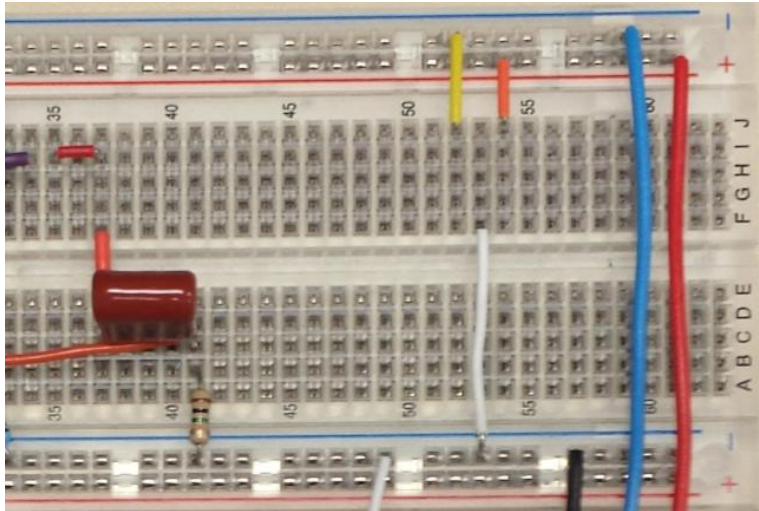


Fig 3: Right Half of Breadboard 1

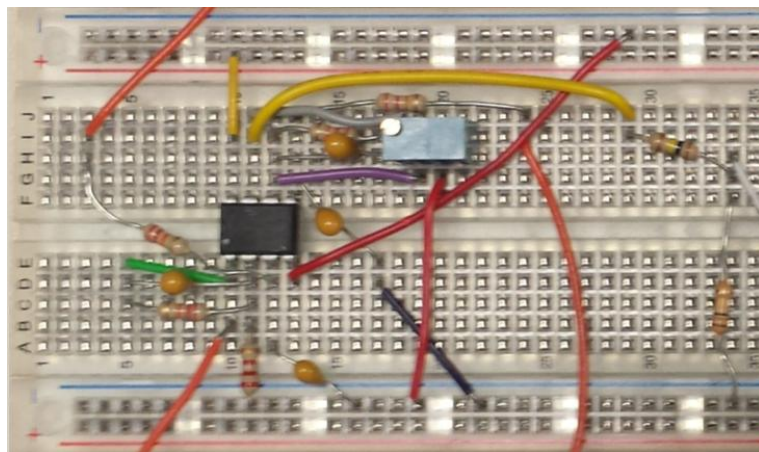


Fig 4: Left Half of Breadboard 2

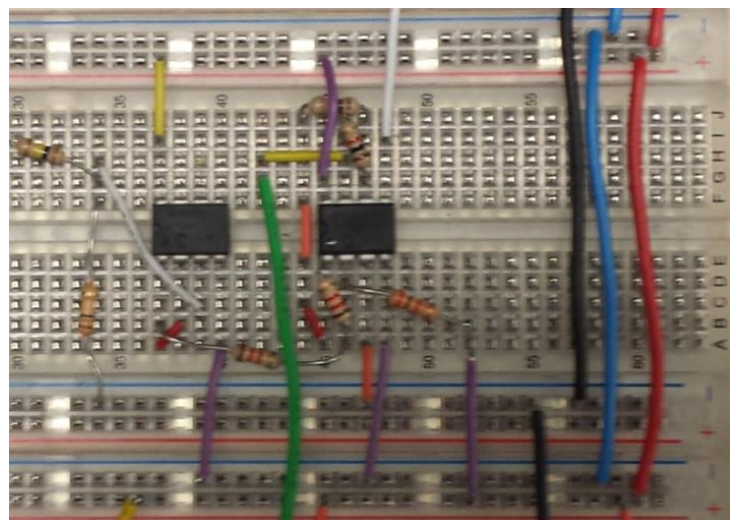


Fig 5: Right Half of Breadboard 2

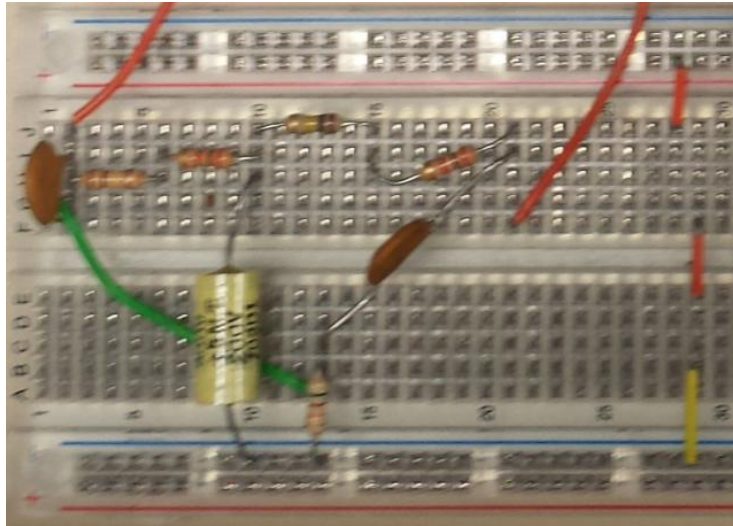


Fig 6: Left Half of Breadboard 3

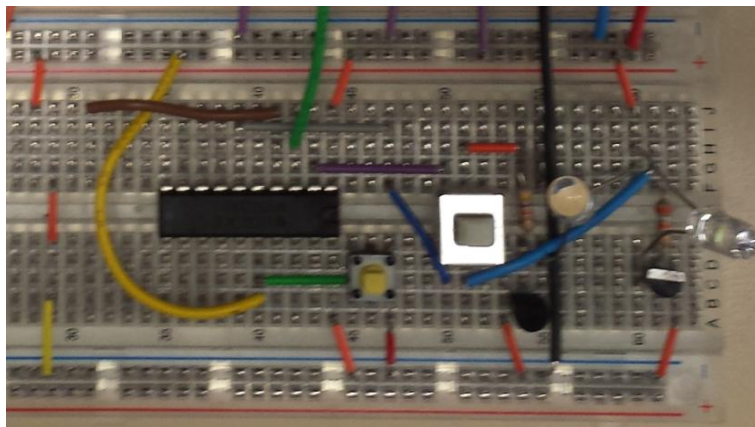


Fig 7: Right Half of Breadboard 3